Wicked Environmental Problems

Managing Uncertainty and Conflict

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PREFACE

This book is based on our work with the United States Department of Agriculture Forest Service (hereafter referred to as the Forest Service) and its efforts to amend national forest plans in the Sierra Nevada region of California. During our research, we came to the conclusion that this decision dilemma meets the requirements of a *wicked* problem. Wicked problems are characterized by a high degree of scientific uncertainty and a profound lack of agreement on values. Further, even though there is no correct decision in the case of a wicked problem, the manager must make a decision. The identification of the Sierra Nevada planning effort as a wicked problem leads to a critical conclusion. Because, by definition, a wicked problem has no optimal solution, the decision maker must seek other measures of success. The book traces our research and findings and proposes an approach to managing or coping with such problems.

Our work began in 2003 when Jack Blackwell, the regional forester for the Pacific Southwest Region of the Forest Service, asked Ronald Stewart to put together a team to answer the question, "How did the region deal with risk and uncertainty in the Sierra Nevada Forest Plan Amendment final environmental impact statement and record of decision signed in January 2001?" The research team consisted of four people with diverse qualifications. Ron Stewart's background is in forest ecology and Forest Service administration. As regional forester in the Pacific Southwest region from 1990 to 1994, he initiated the Sierra Nevada Forest Plan Amendment process when it began in 1992. Peter Balint's experience is in conservation biology and environmental policy. Larry Walters, who once served as a town supervisor, is an expert in public finance and public administration. Finally, Anand Desai brings expertise in public policy analysis and modeling. The team's diversity of training in theoretical, practical, and analytical approaches in both natural and social sciences, combined with personal experience in the specific context of the Sierra Nevada decision dilemma, led us to explore and integrate ideas from a wide range of disciplines.

As we examined the Sierra Nevada case, and three other similar domestic and international environmental planning efforts, we concluded that environmental management agencies rarely identify a problem as wicked even after repeated failed attempts to reach a satisfactory conclusion. Instead, management decisions are typically followed by unproductive cycles of appeals and litigation, failed implementation, and new rounds of analysis and public participation. Each round may include more sophisticated analysis, greater public engagement, and longer and more complex documents, but it inevitably leads to the same conflicted outcome. This failed approach assumes that reducing scientific uncertainty and improving public understanding of the problem will lead to a solution. Our research, however, led us to believe that, while arguments in the context of a wicked problem may be framed around science and scientific uncertainty, the real issue is often deep disagreement on values. In a wicked problem, key stakeholders, including the agency and various interest groups, typically have significantly different and often incompatible worldviews. Yet these profound differences are rarely acknowledged or explored. Thus a missing dimension in the decision process is an effort to explicitly identify and consider the range of values that inform participants' perceptions of the problem and their preferred policy responses.

The defining characteristics of a wicked problem—a high degree of scientific uncertainty and a profound lack of agreement on values, combined with the absence of a perfect solution—led us to propose an approach that builds on the idea of *learning networks*. In a learning network, participants engage in an iterative, analytic, deliberative process to build trust and move toward agreement. In our research, we tested novel techniques to identify public and agency values and preferences and incorporate them into ecological models. The outcomes of these combined models can be used to develop alternative management choices that may otherwise be overlooked but may have the potential to attract broad support. We suggest that the information generated through these techniques could serve as new input in the learning network to help participants move forward. We further recommend that any decision that emerges should be implemented using an adaptive management philosophy to allow flexibility in adjusting to the complexities and uncertainties inherent in wicked problems.

We gratefully acknowledge the financial support of the USDA Forest Service Pacific Southwest Region for the study of the Sierra Nevada Forest Plan Amendment process that formed the basis for this book. We especially recognize the contribution of time and ideas from Regional Forester Jack Blackwell, Deputy Regional Forester Kent Connaughton, Sierra Nevada Forest Plan Amendment Review Team Leaders Mike Ash and Kathy Clement, and Public Affairs Officer Rick Alexander.

We thank the participants in three workshops we conducted in the region. These included members of the Forest Service Regional Management Team and stakeholders from the general public who traveled to meetings in Sacramento to participate in discussions with us and complete two data collection exercises that helped us understand the Forest Service's planning problem.

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values and deliberation—cannot provide an adequate decision-making framework. In other words, when scientific uncertainty coexists with value uncertainty and conflict, we have wicked problems.

Defining Wicked Problems

When government officials and citizens make decisions in the public arena, the decisions occur at various levels of complexity. Some decisions are difficult to analyze, understand, or explain. Problems take on a complexity that often extends well beyond the merely intricate and assumes many forms, including high levels of risk; scientific uncertainty; biological complexity; social complexity; vast scope and scale of the issues involved; and the absence of a clear public consensus on values, the nature of the problem, or acceptable solutions.

Clearly, some public problems are more difficult to resolve than others. Renn (1995) suggests that environmental debates operate on three levels and that ecological risk assessment is less and less helpful in policy making as levels of complexity and conflict increase. For straightforward (well-structured) problems, scientific analysis and traditional analytic approaches may serve as a basis for policy making with little controversy. At a medium level of complexity, public trust in the implementing institutions and their technical expertise is required. It is at the highest level of complexity and conflict that political forces overshadow technical analyses, making stakeholder involvement absolutely essential.

Paris and Reynolds (1983) observe that policy decisions inevitably involve three claims:

- empirical claims about causal relationships, observable levels of key variables, and generally (potentially) verifiable statements about the world;
- normative claims that focus attention on particular concerns and judge the acceptability of the status quo, outcome levels, or important relationships;
- action claims that assert the need for particular policy changes consistent with empirical understandings and in light of normative judgments.

Consider two dimensions of any decision: the state of empirical knowledge necessary to make the decisions, and the level of agreement on guiding values (see table 2.1).

TABLE 2.1. Decision problems, from easy to wicked

	Agreement on Values	
State of knowledge	*High*	*Low*
Well developed	Routine analysis with periodic stakeholder and expert review. Decisions are easy.	Emphasis on stakeholder deliberation with periodic expert review.
Tentative/gaps/ disagreements/ research needed	Emphasis on expert deliberation with periodic stakeholder review.	Emphasis on both stakeholder and expert deliberation. Wicked problems!

Given these two dimensions, there are four possible scenarios:

1. If decision makers understand and generally accept the knowledge base underpinning an issue, as well as agree on what values are most important, then decision making is relatively straightforward and stakeholders may be comfortable with a strategy proposed by an agency or expert.
2. If decision makers do not agree on values, but the science is well understood, then the focus is on dialogue among the stakeholders to understand and resolve value differences.
3. When the science is uncertain and there are important gaps in the knowledge base, but stakeholder value agreement is high, then the focus is on resolving the science issues with oversight and, when needed, with the stakeholders' assurance that their values are reflected in the science and decision making.
4. But when both the science is uncertain and value agreements are low, then the issue will likely become a wicked problem and need significant and repeated dialogue among scientists, stakeholders, and decision makers.

Raiffa (1968) defines a decision problem as a choice among a set of actions. The ideal decision entails selecting the action that optimizes the decision maker's return, where each outcome is assigned a worth or utility to the decision maker. Hence an outcome is associated with an action that is taken in a given context. When the relationship between an action and its outcome is clear, we have a programmed decision (Simon 1960, 5), which falls into the top left-hand quadrant of table 2.1. Problems belong to the top right-hand quadrant when there is uncertainty about goals, values, and objectives, and consequently the utility associated with that action is unclear. This ambiguity is not due to any confusion on the part of the decision maker regarding her personal priorities; instead, it is because she must act on behalf of the public at large. But in the case of the right column of table 2.1, there is no agreement among publics about the values and goals they want to pursue. Some will label whatever the decision maker elects to do as nonresponsive. Problems in such contexts are generally addressed through political means, and the decision makers arrive at the solutions through debate and compromise. On the other hand, when values are clear and the utilities certain, but the outcome corresponding to the action in a given context is not known with certainty, additional information is needed. Problems whose solutions have uncertain and potentially unknown consequences belong in the bottom left-hand quadrant. An unprogrammed decision (Simon 1960) or wicked problem (Churchman 1967; Rittel and Webber 1973) has one or more of the actions, the context, the outcome, or the utility totally unknown or not confidently known (Mason and Mitroff 1973).

Setting Wicked Problems Apart from the Rest

The nature of wicked problems is such that it is difficult to generalize about them; however, they seem to have a number of common characteristics. For example, selecting a solution from a set of limited options solves the usual decision problem. These options are well defined with stable problem statements such that one knows when a solution is reached. Hence, it is possible to objectively evaluate the solutions as either right or wrong, to try out the solutions and abandon them if they do not work (Conklin 2006).

In sharp contrast, the definition of a given wicked problem is in the eye of the beholder; that is, each stakeholder defines the problem differently and therefore there is no uniquely correct formulation of the problem. Because a number of factors, such as resources of ecosystems, communities of interest, funds, and organizational capabilities, combine with stakeholder demands in idiosyncratic ways, any resolution is likely to be one-shot and unique. Also, outcomes are not scientifically predictable, so the decision maker cannot know when researchers have explored all feasible and desirable solutions. In fact, responses to wicked problems are generally better or worse, rather than right or wrong, and it may take a long time before the real consequences of a decision are discovered (Allen and Gould 1986).

These characteristics result in some disturbing problem attributes. Here are the ten propositions offered by Rittel and Webber (1973, 162–67) as distinguishing properties and outcomes of wicked problems:

1. There is no definitive formulation of a wicked problem.
2. Wicked problems have no stopping rule.
3. Solutions to wicked problems are not *true* or *false*, but *good* or *bad* or *better* or *worse* or *satisfying* or *good enough*.
4. There is no immediate and no ultimate test of a solution to a wicked problem.
5. In a wicked problem, there is no opportunity to learn by trial and error. Every solution is a one-shot operation.
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered a symptom of another problem.
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
10. The planner has no right to be wrong.

These propositions focus primarily on two aspects of the problem: its definition and the nature of the solution. As propositions 1 and 7 suggest, attempting to formulate the problem is itself a problem. Further, because of the situation's uniqueness, it is not always possible to turn to other similar situations for potential insights. In a wicked problem, there is ambiguity about the nature of the problem. Often there is no single problem but a combination of multiple intractable problems that are unearthed during the process of problem definition. If we think of a problem as a discrepancy between the current state of affairs and a desired state (proposition 9), then the solution has to eliminate the discrepancy. Hence, how we choose to explain the discrepancy will determine the type of solution we seek.

However, there are no criteria that tell when *the* solution or *a* solution has been found in dealing with wicked problems. Because (a) the process of solving the problem is identical to the process of understanding its nature (proposition 9), (b) there are no criteria for determining what is a sufficient understanding of the underlying issues (propositions 4 and 6), and (c) there are no ends to the causal chains that link interacting open systems—the manager/planner can always invest more efforts to increase the chances of finding a better solution (proposition 2). Rather than solving it, the manager often terminates work on a wicked problem for external considerations: not enough time, money, or patience.

Rittel and Webber (1973) suggest that even short-term "solutions" do not end wicked problems (proposition 4) because the problems are dynamic, and social and scientific parameters will change over time. With wicked problems, any solution implemented will generate waves of consequences over an extended period of time. Additionally, there is no way of tracing these waves through all the affected lives since the full consequences cannot be appraised until the waves of repercussions have completely run their course—which may, in the case of issues involving forest ecosystems, take decades or even centuries.

Decision makers disagree on the exact definition of any particular wicked problem; consequently, the criteria are not clear for judging solutions. Judgments regarding whether a solution is true or false are likely to differ widely depending upon the stakeholder community or personal interests and values (proposition 3).

Living with Wicked Consequences

Although one can learn lessons from implementing solutions, proposition 5 raises an interesting issue about the utility of the lessons learned for the current problem. In saying that "there is no opportunity to learn by trial and error," Rittel and Webber (1973) are not suggesting that there are no lessons to be learned, but rather that the lessons learned will come too late to help with the problem at hand. By this time, the situation has evolved into something different (proposition 8), which requires a redefinition and reformulation of the situation that now needs addressing. To illustrate, Rittel and Webber give the example of building a freeway where the implementation of the decision has long-term consequences and is not readily reversible. So it becomes important that there be a general consensus regarding the course of action and a willingness to live with the consequences.

Traditional decision theory (Raiffa 1968) focuses on the selection of an option from a set of differently desirable choices, each of which has its own costs and benefits. Proposition 6 however, suggests that such a set of potential solutions does not exist for wicked problems, in part because there are no criteria that enable someone to prove that all relevant solutions have been considered. With these ill-defined problems and solutions, the set of feasible plans of action relies on realistic judgment and on the amount of trust and credibility between policy makers and the public, which may be small or nonexistent.

And finally, proposition 10 draws the distinction between an administrator's and a scientist's job. In science, solutions to problems are considered hypotheses to be refuted. And, the scientific community does not blame its members for postulating hypotheses that are later refuted. In dealing with policy issues as they relate to wicked problems, however, planners are liable for the consequences of their actions or inactions. Here, the aim is to find ways to improve some characteristics of our world; thus a policy's effects can matter a great deal to people touched by the actions taken.

Natural Resource Problems

Most, but not all, large-scale planning issues involving the *commons* have become controversial. Public values combine with issues of scientific uncertainty and geographic scale to create wicked problems. Citizens are concerned about public lands, oceans, and the atmosphere meeting natural resource supplies, accommodating rural community demographic changes, and adjusting to declining populations of certain plants and animals. Salwasser (2002) addresses the nature of natural resource problems in today's decision environment, characterizing them by

- their complexity and messiness: no definitive problem statement, and multiple problems with multiple objectives;
- the existence of fragmented stakeholders: both in interests and in tactics used to pursue their interests;
- scientific messiness: multiple factors influence each problem area or objective, and the manager can only influence some of these factors;
- two kinds of uncertainty: (1) we do not know but can eventually learn, and (2) we cannot know until it occurs; to this we add a third—we do not know that we do not know;
- conflicting risks: there are conflicting risks among objectives and between short-term and long-term objectives; and
- dynamic social, economic, knowledge, and technological systems.

The sociopolitical and environmental systems involved in natural resource issues have both time and spatial dimensions. For instance, the regulations implementing the National Forest Management Act of 1976 require that the US Forest Service maintain viable species populations throughout their range when considering forest plans and individual projects. Environmental activists are concerned that a piecemeal approach with individual plans made in a portion of a species' range might cumulatively jeopardize the species' long-term viability as each separate individual plan is implemented. The worry is that the cross- or multi-jurisdictional nature of species (which do not adhere to human-made boundaries) has increasingly forced the agency to consider creating large, landscape-scale planning efforts to prevent cumulative negative effects of incremental decision making. At the same time, the planning regulations require preparing and implementing forest plans by each local planning unit, generally the individual national forest. Planning across distinct administrative units increases complexity and adds to the number of issues and problems that must be addressed in the planning process, including the number of stakeholder participants. The complexity is further compounded when decision makers have to consider transnational issues, for instance, in the European Union.

In addition to these scale issues, the long time frames of ecological response, and the short time frame of the sociopolitical process and changing societal values, result in an even more complex wicked problem. On the time scale, the sociopolitical environment can be rather volatile, changing with the next election or lawsuit. Planning is also limited in terms of human lifetimes of those people involved on the project, thus it is difficult to successfully complete multigenerational projections. On the other hand, natural environments—for example, river basins or forests—change continuously, but slowly, on the order of decades and even centuries. Experimentation to resolve issues of uncertainty may take decades; in the meantime, the sociopolitical process may demand faster resolution or change in direction before we can know if the old direction was satisfactory. This is further complicated by the long time frame of a complex, large-scale planning process, in which the issues that initially framed the planning process could change before the decision is reached.

At the landscape scale, there are issues of both local and universal concern, especially with respect to species that have wide ranges. Further, all issues have both a stakeholder community of place—those most immediate to the affected area—and a stakeholder community of interest—a broader group that can live anywhere, and who, if disenfranchised, can resort to competitive strategies to assert their rights. Those interested in community-of-place issues can often find more ready agreement because they share a common interest in the local community and have to coexist after the debate ends and the decision is made. For these same reasons, it is much harder for the broader community of interest to make necessary compromises and move forward. It is also more difficult for the decision makers to identify future stakeholders and to find ways to meaningfully engage them in the planning process. Yet, given the controversy over managing the nation's forests, wetlands, climate, and so forth, there are likely to be few issues that are purely of local community interest, assuming there exists such a thing as a static local community.

Thus, wicked problems are extremely complex and generally unsolvable. However, and perhaps because of their complexity and seeming intractability, there is a growing body of literature and practical experience contributing to understanding and, perhaps, *managing* such problems.

Understanding Open and Closed Ecosystems

In the past several decades, there has been a major change in understanding ecosystems. Formerly, the dominant paradigm was of ecosystems that, when mature, were stable. They were thought to be closed, unaffected by external influences, deterministic, and self-regulated. If this stable condition were to be disturbed, an ecosystem was expected to progress through a series of successive stages back to its original, stable, homeostatic state (Daly 1993). Nature, unfortunately, does not work this way.

The current paradigm is that open systems are in constant states of flux, affected by a series of stochastic factors originating both inside and outside the ecosystems. As a result, these systems are probabilistic and multicausal rather than deterministic and homeostatic like closed systems (Daly 1993). The current model also recognizes that human impacts almost always play an important, and often dominant, role in affecting a system's status (Smith 1997). Present knowledge also emphasizes that uncertainty is central to managing living resources. It follows, then, that ecosystems are characterized by uncertainty—in their basic ecology and biology, in their economic parameters, in the effect(s) of management actions, and there is even uncertainty as to whether or not it is possible to achieve management objectives. Therefore, policy makers, managers, and the public must recognize uncertainty as an overriding factor.